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STUDENT REPORT

LANTIRN SIMULATOR TRAINING
IN THE F-16C

MAJOR MICHAEL L. HAUSER 88-1175

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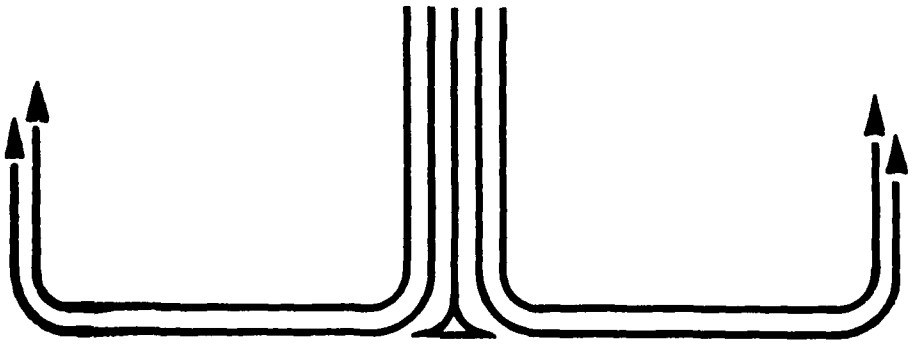

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The LANTIRN system was built to allow low level night operations in the F-16C and F-15E. Because the system is so complex, a thorough simulator training program is required to develop pilot proficiency and minimize the inherent training hazards. This paper details such a training program for the F-16C and explains the thought process used in the development of the program.

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PREFACE

The cover of darkness and weather has long been a sanctuary for ground forces against air attack. The need to deny this sanctuary to the enemy has led to the development of night fighting equipment designed to work below the weather. The LANTIRN system for tactical fighter aircraft will soon be giving this great capability to Air Force F-15E and F-16C tactical fighter units. Unfortunately, training with this equipment can be extremely hazardous because of the complexity of the mission and the proximity of the ground. This paper details a simulator training program for the LANTIRN-equipped F-16C. The training missions outlined in the Appendix will be incorporated into the LANTIRN training program now being developed at Luke Air Force Base. These simulator training missions will help to train an F-16C pilot for the rigors of his mission while managing the risks associated with this sophisticated weapons system.

Special thanks is due to Major John J. Moffatt of the 4444 Operations Squadron, Detachment 1, at Luke Air Force Base. His timely assistance and endless supply of information about a totally new system made the project considerably less complex. Also, Lt Col Frederick E. Bassett of the Air Command and Staff College served as a pathfinder in the completion of this paper. Without his keen insight and helpful criticism, this project would have lacked the tactical orientation that is so vital to effective fighter training.

ABOUT THE AUTHOR

Major Michael L. Hauser graduated with honors from the United States Air Force Academy in 1976 with a degree in Computer Science. After pilot training at Williams AFB, Arizona, he entered F-4 training at Homestead AFB, Florida, and went on to an assignment at Hahn AB, West Germany, in 1978. While in Germany, Major Hauser served as an instructor pilot and flight examiner in the F-4E and later, the F-16A aircraft. In 1983 he was assigned as an instructor pilot in the F-16A at Luke AFB, Arizona. At Luke, he received a Masters in Business Administration and was selected to be one of the first four instructor pilots in the new F-16C tactical fighter. Responsible for the development of academic training for this new aircraft, Major Hauser designed a program that was used to train all F-16C pilots for the United States and four foreign countries. For his work in the F-16C program, Major Hauser was chosen as the 1985 Instructor Pilot of the Year for the 58th Tactical Training Wing.

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Chapter One

INTRODUCTION

The cover of darkness and weather have traditionally had a severe impact on the abilities of air forces to wage war. Although past conflicts have seen the limited use of air power at night and in the weather, the modern high threat battlefield has driven air power into the low altitude structure where night or poor weather operations are extremely hazardous. Modern, capable air defense weapons have given the enemy the ability to use darkness and poor weather as valuable counters to the great capabilities of modern fighter aircraft. The ability to move troops and supplies without danger of air attack is a tremendous advantage on the battlefield, requiring the United States to take steps to equip its fighter and attack aircraft with systems that will allow effective air operations in the low altitude environment at night or under the weather. One of these systems is LANTIRN, Low Altitude Navigation and Targeting Infrared System for Night. LANTIRN is designed to be used on the F-15E and F-16C.

Even with the sophisticated LANTIRN system, a pilot is faced with an extremely demanding operating environment. Flying a fighter at low altitude can be a hazard even during ideal weather conditions in the daytime, but the task loadings during a low altitude night mission in limited visibility against a complex threat array can be extreme. A pilot must be trained to a high proficiency level to prevent loss of the aircraft to ground impact or hostile anti-aircraft fire. Unfortunately, training for this environment can be hazardous, and the type of training that must be accomplished could lead to high training losses. The answer is to use a specially designed simulator coupled with an effective training program to take the pilot from entry level skills to proficiency in all facets of LANTIRN operation. This paper will discuss such a training program for the F-16C. I will cover the operation of the LANTIRN system, the training requirements that the simulator program

must meet, and the specific training events that will be used to teach an F-16C pilot how to use the LANTIRN system to effectively deliver his ordnance in poor weather or at night against a hostile threat array. The actual simulator missions are contained in Appendix A.

Chapter Two

OVERVIEW OF THE LANTIRN SYSTEM AND TRAINING REQUIREMENTS

The LANTIRN system consists of two pods that mount on special fuselage stations on the F-16C. The first pod is the Navigation Pod. It utilizes two internal systems, the Forward Looking Infrared system, or FLIR, and the Terrain Following Radar system, or TFR. The FLIR portion of the Navigation Pod is designed to passively detect infrared energy (1:5) and convert it to a television-like display for the pilot. (2:2) This display is located directly in front of the pilot's head and is called the Head's Up Display, or HUD. The HUD FLIR display looks like a normal daytime television image of the terrain in front of the pilot. The TFR system complements the FLIR system by using radar to detect the actual terrain contour and determine flight path guidance information. (2:2) This guidance information can be coupled directly to the aircraft autopilot for automatic terrain following or provided as a set of symbols superimposed on the FLIR picture in the Head's Up Display to allow the pilot to fly it manually. With both the TFR and FLIR information displayed literally right in front of his eyes, an F-16 pilot can fly the aircraft at extremely low altitudes at night or under the weather and still keep his head up to observe threats or other hazards to flight.

The other key element of the LANTIRN system is the Targeting Pod. Like the Navigation Pod, it mounts on a special fuselage station on the F-16. Its purpose is to detect targets through their infrared emissions and allow the pilot to direct his weapons against the targets he selects. Like the Navigation Pod, the Targeting Pod displays a television-like picture of the target to the pilot, but this information is not shown on the Head's Up Display in front of the pilot's eyes. Instead, it is displayed on one of two television screens in the cockpit. (2:2) The Targeting Pod has two different displays, Wide Field of View (WFOV) and Narrow Field of View (NFOV). WFOV gives the pilot a larger area to examine than NFOV and is

used mainly for detecting targets. NFOV is a more magnified display that the pilot uses to lock the aircraft and weapon sensors to the target for weapons delivery. (2:2) Additionally, the Targeting Pod incorporates a laser that can be used to increase weapons delivery accuracy, if desired. (2:2) Overall, then, the Targeting Pod is a very sophisticated device that has the potential to demand a large share of the pilot's attention.

Because the F-16 is a single-seat fighter, the Air Force tasked the aircraft designers to build a cockpit that would allow a pilot to efficiently manage the complex LANTIRN system. The resulting F-16C cockpit is very different from that built for earlier models of the aircraft. Basically, all critical mission switches and controls were moved up into an integrated panel located just below the Head's Up display to allow easy in-flight access. The Head's Up Display was made wider to give the pilot a bigger, more comprehensive display. To accomodate the radar, weapons, test, and Targeting Pod displays, the cockpit has two television screens located just below the cockpit glare shield. Critical controls are located on buttons immediately adjacent to these television screens, giving the pilot immediate access to the switches he needs to do the job. Even with the resultant excellent cockpit layout, however, the LANTIRN F-16C pilot has a heavy cockpit workload. He has to fly the aircraft with reference to the Navigation Pod information, or at least monitor aircraft performance when certain automatic pilot modes are used. He has to select the correct weapons to be used and ensure that correct arming sequences are followed. He has to operate the Targeting Pod to ensure that the correct targets are selected for weapons delivery. And to make matters worse, he has to do all this in a high threat environment at very low altitude at night or below the weather.

To help the LANTIRN pilot to be proficient at these difficult cockpit tasks, Tactical Air Command has developed concepts to maximize training while minimizing the risks inherent in the LANTIRN flight profiles. First, the training philosophy to be used in designing the simulator missions will be to work gradually from simple tasks up to the complex. (4:9) Second, there will be seven total simulator missions of one and one-half hours duration to allow each pilot ample opportunity to learn basic LANTIRN operation and progress to realistic weapons employment. (6:5) These missions will be spaced throughout the program to make them mesh effectively with the actual aircraft missions. In other words, a pilot will fly one or two

simulator missions, advance to the aircraft to apply what he has learned, then return to the simulator to repeat the cycle. To make the simulator training as realistic and meaningful as possible, the low level routes flown in the simulator will be the same as those flown in the aircraft, and the routes selected will present the pilot with different types of terrain and simulated in-flight visibility ranging from perfect daytime conditions to poor weather nighttime. Weapons deliveries will also be practiced on each mission and will be designed to familiarize each pilot with the correct procedures needed to employ the AGM-65D Imaging Infrared Maverick missile, laser guided bombs, and conventional free fall bombs. Finally, the enemy threat array will be simulated, giving the pilot the opportunity to practice proper countermeasures in the low altitude, degraded visibility conditions that can be expected on a typical wartime LANTIRN mission. (7:-) Armed with this simulator training, the LANTIRN pilot will be able to rapidly employ the system in the aircraft.

Chapter Three

NAVIGATION POD TRAINING

As mentioned earlier, the Navigation Pod is one of the key components of the LANTIRN system. Even though it is a complex high-technology device, however, it is designed to keep the pilot's workload to a manageable level. One of the key features of this pod is the Automatic, or AUTO, mode. The AUTO mode allows the pilot to couple the aircraft autopilot to the TFR portion of the Navigation Pod. With the AUTO TFR engaged, the system will fly the aircraft at a preselected altitude above the ground and guide the aircraft along a preprogrammed low level route. To do this, all a pilot needs to do is program the low level route into the aircraft, engage the AUTO TFR, and ensure that the throttle is set to maintain the desired airspeed. With this degree of automation, the pilot is free to do the myriad of other tasks necessary on a typical combat mission.

The other TFR mode available is the MANUAL mode, which as its name suggests, requires the pilot to fly the aircraft manually. To do this, the TFR system puts guidance cues in the Head's Up Display, and the pilot flies the jet by following the cues. Even though this sounds relatively simple, it requires much more attention than the AUTO mode, as the pilot has to fly, navigate, and still keep up with the other cockpit duties. The obvious result is that the pilot has a higher cockpit workload.

One other eventuality that must be addressed is training a pilot to cope with Navigation Pod malfunctions. Although the system is expected to follow the high reliability standards already enjoyed in the F-16C community, no system works perfectly one hundred percent of the time. Unfortunately, problems with this system can be especially hazardous because the normal mission profile involves flight at low altitude in poor weather at night. The bottom line is that any simulator training program needs to allow an upgrading pilot to see the expected failure

modes and learn to cope with them in the safety of the simulator.

My approach to Navigation Pod training can be seen in the Simulator Missions contained in Appendix A. However, for ease of reading I have summarized the Navigation Pod training in Table 1. The seven simulator missions are numbered 0-1 through 0-7, following the TAC method of labeling simulator missions. ("0" stands for OFT, or Operational Flight Trainer, which is how the simulator is referred to in TAC training materials.) As the table illustrates, the building block approach is used throughout. To begin with, a student's first mission is in the daytime. His first exposure to the Navigation Pod is an introduction to the easier AUTO mode, and halfway through the low level training route he transitions to the more difficult MANUAL mode. In addition, his first experience with the MANUAL mode includes a look at all the warnings that the mode will display if system limitations are exceeded. The first mission is planned to be flown at 500 feet, a proficiency level that an upgrading pilot will have prior to course entry (4:3). Next, the weather will be clear, and the terrain will be relatively level. To do this, I have selected low level route VR 223, which is one of the more common training routes flown to the Luke gunnery range

	Time of Day	Altitude	Terrain	Weather	Mode
0-1	Daytime	500 ft	Level	Clear	AUTO & MANUAL
0-2	Daytime	200 ft	Level	1000' Cg 4 NM Vis	AUTO & UPDATES
0-3	Daytime	200 ft	Varied	500' Cg 4 NM Vis	MANUAL & UPDATES
0-4	Night	500 ft	Varied	Clear	AUTO & FAILURES
0-5	Night	500 ft	Varied	1000' Cg 4 NM Vis	AUTO, REVERT TO MAN
0-6	Night	200 ft	Varied	500' Cg 4 NM Vis	CHOICE
0-7	Night	200 ft	Varied	500' Cg 4 NM Vis	CHOICE

Table 1: Flow of Training for the Navigation Pod

complex. This route is depicted in Appendix B. Note that there are some mountains along the route, but there are long stretches of level terrain. I have personally flown this route a large number of times, and my own instructor experience has shown it to be an excellent route for training students at an entry level.

The next step up the training ladder finds the student on Mission 0-2 employing the Navigation Pod in the AUTO mode, but this time his task loading is increased slightly; he must also perform updates to the inertial navigation system (INS) and the Fire Control Computer (FCC); these are both key parts of the weapons delivery system. The INS updates are called "fixes" and the FCC is updated via an altitude calibration, abbreviated ACAL. The ACAL is done to ensure that the FCC has the correct altitude information to use in weapons delivery computations. Additionally, the pilot is tasked to step his altitude from five hundred feet above the ground to two hundred feet, an altitude expected to be used on operational missions. (4:13) He is still flying in daytime conditions, but I have added a relatively low cloud ceiling of one thousand feet above the ground. This should not be too challenging, as it is still eight hundred feet above the planned flight altitude, and it is over the same route he flew on the previous mission. I have also cut the visibility down from unrestricted to four nautical miles, a value I know from experience to simulate degraded European visual conditions. Overall, then, the student is challenged more than on his first mission, but the proficiency level expected of him should be attainable.

The third mission finds the pilot employing the MANUAL mode and performing the same updates practiced on the previous mission. By this time he should have some proficiency with the Navigation Pod, and flying the aircraft and performing these updates is a reasonable increase in task loading. He is still flying the aircraft in daytime conditions at two hundred feet above the ground, but I have decreased the cloud ceiling to five hundred feet, simulating the degraded conditions a pilot is likely to encounter on a combat mission. The visibility remains at four miles, however, because I have found the visual simulation to be somewhat unrealistic with settings below this value; consequently, this is the lowest setting used on any simulator mission. Note that the terrain has been changed. The pilot will fly low level route VR 245 (depicted in Appendix C), which has stretches of both level terrain and mountainous rough terrain. This will challenge the pilot an increment more than the previous mission, but he will still

be flying one of the routes that will be used in the actual aircraft missions.

Mission 0-4 finds the upgrading pilot on his first night mission. Because the daytime visual cues are now gone, the weather has been set back to clear conditions and the planned flight altitude is back to five hundred feet above the ground. For his first night work, he is back on the relatively level terrain of route VR 223, and he is back on the simpler AUTO mode. However, he will be tasked to perform the updates he has seen twice before, and the instructor will introduce some TFR failures for him to deal with. Thus, pilot tasking is relaxed in weather, terrain, and enroute altitude, but his expected greater proficiency with the system is a basis for introducing some system degradation.

The second and third night missions follow the general flow of the second and third daytime missions. The weather is progressively lowered to the same degraded settings used in the daytime missions, and the enroute altitude is lowered to two hundred feet on the third night mission. This is not as rapid a stepdown as was done in the day missions, but the pilot is more heavily tasked on Mission 0-5 by having to recognize a system malfunction that requires him to transition to the more demanding MANUAL operation. Commensurate with his increasing proficiency with the system, he is transitioned more rapidly to the varied terrain of route VR 245. Also, on Mission 0-6 he is allowed to choose whether he uses the AUTO mode or the MANUAL mode. I have included this choice because at the time of this writing there is no field experience with the AUTO mode, and I anticipate that there may be times when it is better to use one mode over the other. My own experience with early training in the F-16C indicates that it is prudent to design these options in from the beginning.

The last training mission is designed to be a consolidation of the skills the pilot has learned on the previous six missions. As much as possible, 0-7 is designed to be a realistic combat mission from beginning to end. The mission is flown in poor weather at night and at very low altitude. The terrain is varied, and even though it is a route the pilot has flown before, he will be challenged by a capable threat array, as we will see later. This mission will be a good measure of how well the upgrading pilot has learned the capabilities of the Navigation Pod. Satisfactory performance on this demanding profile will indicate that he is ready for greater challenges in the actual aircraft.

Chapter Four

TARGETING POD TRAINING

A pilot learning to use the LANTIRN system will rapidly discover how important the Navigation Pod is to mission success, as it guides him below the weather and allows him to find the target area in challenging visual conditions. However, finding a pinpoint target and bringing ordnance to bear on it requires a bit more precision. To handle this chore, the Targeting Pod comes into play. Like the Navigation Pod, it utilizes infrared detectors to display a selected area on the ground, but it has the added ability to present a magnified image for closer pilot examination. As discussed earlier, the Targeting Pod has two different displays, Wide Field of View (WFOV) and Narrow Field of View (NFOV). WFOV is used to display the target area, and NFOV gives the pilot a magnified image. Unlike the Navigation Pod displays, however, Targeting Pod images are displayed on a separate cockpit television screen. As a result, the pilot has to use the Head's Up Display in front of his eyes to use the Navigation Pod information, but he has to look in a different place for the Targeting Pod information. Clearly, there is a high potential to overtask the pilot.

As was the case with Navigation Pod training, Targeting Pod training is designed to lead the pilot gradually from the simple tasks to the more challenging ones. This teaches him to effectively manage his cockpit duties to prevent overtasking. Also, this program will only teach the more basic uses of the Targeting Pod; the Navigation Pod will receive the most emphasis. (8:-) Table 2 (next page) is a summary of the training approach I have used with the Targeting Pod; it repeats the information found in the actual mission outlines in Appendix A. As the table shows, the first simulator mission does not include any Targeting Pod training. My reason for this is that the Targeting Pod is meant to complement the Navigation Pod; consequently, the pilot needs to be familiar with the Navigation Pod before he tackles the Targeting Pod. In the same light, the

Navigation Pod requires more training time early in the program to allow the pilot to familiarize himself with the AUTO and MANUAL modes. As a result, there is insuffucient simulator time in the first mission to allow any training in the Targeting Pod System. However, there is ample time to incorporate this training on later missions where the pilot's increasing proficiency wih the Navigation Pod will allow him to learn the Targeting Pod system more efficiently.

	Time of Day	Function Performed
O-1	Daytime	None
O-2	Daytime	-System Updates (AUTO TFR) -Level CCIP, 30 Degree CCIP, and Toss Deliveries
O-3	Daytime	-System Updates (MANUAL TFR) -Basic AGM-65 Deliveries
O-4	Night	-System Updates (AUTO TFR) -CCRP level and Toss deliveries, Level and 30 Degree CCIP
O-5	Night	-Level CCIP, 30 Degree CCIP, and Toss Deliveries
O-6	Night	-Target detection to AGM-65 deliveries -Armed recce to detect and attack moving ground targets
O-7	Night	-System updates as required -Weapon delivery and armed recce at pilot's discretion

Table 2: Flow of Training for the Targeting Pod

Mission O-2 is the pilot's first look at the Targeting Pod. Because his inexperience with this system will demand a bit more attention, I have his first Targeting Pod work done on the low level route with the Navigation Pod in the AUTO TFR mode. Remember that the AUTO TFR mode flies the aircraft at the desired altitude and over the planned ground track with the pilot's main duties being to simply monitor

the system and have the throttle set to hold the desired airspeed. Consequently, the pilot will be able to devote a large amount of his attention to the Targeting Pod and the steps he needs to follow to perform simple system updates. Once he arrives at the gunnery range, the Targeting Pod is brought gradually into the pilot's training. His first use is a level weapons delivery, which by its nature is simple. In the same way, he uses the simplest weapons delivery mode, Continuously Computed Impact Point, or CCIP. An F-16 pilot selected for LANTIRN training will be very familiar with level CCIP deliveries because of his earlier training, and he will be able to easily incorporate Targeting Pod functions with this simple training event. Note also that he is on his second daytime mission, with weather that is not severely degraded. From this initial familiarization with the Targeting Pod, he moves to a dive bomb delivery using a slightly more difficult thirty degree dive angle. Finally, he uses the system to perform a toss delivery, which again is slightly more challenging. In this delivery he will acquire the target and use the Targeting Pod to give target range data to the weapons delivery computer as he approaches low to the ground and level, then flies up to toss the bomb on the target. Again, this is a bit more complicated, but easily within the pilot's capabilities at this time.

Mission 0-3 finds the student back on the low level route for his next work with the Targeting Pod. In this last daytime mission, he will be challenged by the MANUAL TFR mode, varied terrain, and the most degraded weather he has seen yet. However, his Targeting Pod tasks on the low level route will merely be a repeat of the system updates he performed on his last mission. Given the poor weather and more varied terrain, this will be a good incremental increase in tasking. Once he has completed the low level route, he will be tasked with using the Targeting Pod for weapons delivery. On this mission, he will be using the more complicated AGM-65 Maverick missile. This weapon requires a fairly large amount of cockpit work; consequently, the Targeting Pod is only brought into weapons deliveries after the student has been able to practice more basic deliveries without it. This will meet the goals of gradually challenging the student (4:9) and keeping Targeting Pod training at a basic level. (8:-)

The next mission, 0-4, puts the pilot in the night environment with AUTO TFR and at a higher altitude on the low level route. Targeting Pod work on this portion of the mission will involve only simple system updates, and after

this mission the pilot will use the Targeting Pod on the low level route only for updates at his discretion. Keep in mind that this program is a very basic introduction to the Targeting Pod (8:-), resulting in a tradeoff between training with this pod and training in other areas. At this point in his training, he will also be faced with learning how to defeat threats at low altitude and in the dark, as we will see later. On the gunnery range, however, Targeting Pod training will continue. On Mission 0-4, the pilot will begin with level deliveries using a radar delivery mode called Continuously Computed Release Point, or CCRP. This is a simple delivery mode and a good choice for his first night deliveries with the Targeting Pod. After he has warmed up with level deliveries, he goes on to slightly more challenging toss deliveries, and from there he progresses to level visual and dive bomb deliveries. For his first night mission, then, a student moves from simple to complex with the Targeting Pod, just as he does with other training events.

Mission 0-5 puts the pilot on a night mission with degraded weather, but his Targeting Pod training is kept simple. Instead, emphasis is placed on weapons delivery, as we will see in a later chapter. Training for the Targeting Pod on this mission is a repeat of the training he received on Mission 0-2, which should be well within his capabilities. Mission 0-6 is a slightly larger step up in difficulty as the pilot uses the Targeting Pod as an aid to delivering the AGM-65 Maverick missile. Also, the pod will be used to detect ground moving targets as he does armed reconnaissance, for which it is well suited. From this point on, no new training events will be introduced for the pod. Mission 0-7 is a simulated combat mission, and the pilot will decide how he wants to employ the Targeting Pod on the mission. There is an armed reconnaissance portion of the mission, but the pilot may use the Targeting Pod or one of the other systems in the aircraft.

In summary, Targeting Pod training follows the same approach as that used for the Navigation Pod. The student begins with simple tasks in a daytime environment and moves to more difficult tasks at night. Although the training is only at a familiarization level (8:-), an upgrading pilot should be ready for more advanced training once he reaches his operational unit.

Chapter Five

WEAPONS DELIVERY TRAINING

The basic job of an F-16 pilot is to put his bombs on the target. Consequently, weapons training receives heavy emphasis throughout this program. An upgrading pilot will practice weapons delivery on each and every mission to help him hone his skills for combat. Like his training for the Navigation and Targeting Pods, weapons delivery training proceeds from the simple to the complex.

A LANTIRN F-16C pilot will receive training in three types of ordnance, basic free fall bombs, laser guided bombs (LGB's), and the AGM-65 Maverick missile. An F-16 pilot selected for LANTIRN training will have already received extensive training in basic free fall bombs in earlier F-16 training programs, but many pilots will be unfamiliar with LGB's and AGM-65's. The reasons for this are that laser guided bombs and Maverick missile employment are not currently given in basic F-16 training courses, and not all pilots receive this training in their operational units. Also, weapons training for LANTIRN pilots needs to emphasize slightly different attack profiles in some cases, as the LANTIRN picture that a pilot uses in his attack is no larger than the size of the Head's Up Display. In other words, he needs to learn to attack the target by using a relatively small window on the world rather than the normal daytime visual cues he is used to. All of these factors contribute to the weapons training designed for this program.

Table 3 (next page) summarizes the flow of weapons training. A glance at the table shows that a student starts daytime training with basic free fall bombs (the 500 pound MK-82), steps up to LGB's, and then progresses to the more difficult AGM-65. Once he moves into night training, he goes through the same simple-to-complex sequence. The last mission uses MK-82's as the weapon of choice because this is expected to be the most commonly used weapon on an actual combat mission.

	Time of Day	Weapon	Delivery Modes
0-1	Daytime	MK-82	CCIP & CCRP Level 20 & 30 Degree CCIP Low Angle Strafe
0-2	Daytime	LGB	20 Degree Direct Approach without Tgt Pod Level & 30 Degree CCIP with Tgt Pod Toss with Tgt Pod
0-3	Daytime	AGM-65	Visual and Preplanned attacks without Tgt Pod Armed Recce with Tgt Pod
0-4	Night	MK-82	CCRP level and toss deliveries with Tgt Pod Level CCIP with Tgt Pod 30 Degree CCIP with and without Tgt Pod
0-5	Night	LGB	20 Degree Direct Approach without Tgt Pod Level & 30 Degree CCIP with Tgt Pod Toss with Tgt Pod
0-6	Night	AGM-65	Visual and Preplanned attacks with Tgt Pod Armed Recce with Tgt Pod
0-7	Night	MK-82	Single pass on a preplanned target Armed Recce Tgt Pod use left to pilot discretion

Table 3: Flow of Training for Weapons Delivery

As for the weapons delivery events on each mission, the pilot begins his training on 0-1 with a basic review of weapons delivery modes he already knows from earlier training. The idea here is that the first mission is his first look at the LANTIRN system, and the unfamiliar Head's Up Display and other new features will require that he change some of his habit patterns. The best way to do this is to start with familiar training events and allow him to learn not only those things that are new, but also reconfirm those things that are familiar. Consequently, the weapons training on 0-1 consists of CCIP and CCRP level deliveries and basic dive bomb patterns on a simulated scorable gunnery range. Low angle strafe is also included to let the pilot work on his crosscheck with the new Head's Up Display. Later missions do not include strafe because strafe is difficult to do realistically in a simulator; lack of real

three dimensional cues make range estimation difficult, and most pilots fire from excessively close ranges in the simulator. This is not a habit that is desirable in the real aircraft.

Mission 0-2 finds the pilot back on a scorable gunnery range, but with degraded weather and laser guided bombs. To prevent the weather from being too adverse a factor on what is probably a pilot's first use of LGB's, I have specified in the mission outline that the weather is to be raised to one thousand feet above the highest weapons delivery altitude to be flown. This mission also marks the pilot's introduction to the direct attack. In this delivery profile, the pilot flies low to the ground directly at the target and then does a straight ahead pullup. He uses the LANTIRN cues in the HUD to acquire the target and then rolls in for the delivery. (For those familiar with basic pop-up attacks, the direct approach is essentially a direct pop-up.) To keep this introduction to a new attack simple, I have chosen the delivery to be done with a final dive angle of twenty degrees. This is not excessively steep, nor is it too close to the ground; it is designed to minimize disorientation. Once he has learned this profile, the student advances to level CCIP deliveries incorporating the Targeting Pod, as discussed in the previous chapter. Next, he uses the Targeting Pod in a basic thirty degree dive bomb attack, finishing his work with toss deliveries also incorporating the Targeting Pod. This, then, is a busy mission, but it follows the basic concept of starting simple and increasing the level of difficulty.

Mission 0-3 is designed to acquaint the pilot with the AGM-65 Maverick missile as it draws on his increasing experience with the LANTIRN system. The pilot's target area is changed from a simulated scorable gunnery range to a tactics range with its more realistic targets. This is a step up in difficulty and realism, and the targets on a tactics range are better suited to working with the optically-guided AGM-65. Because this may be a pilot's first exposure to this weapon, I have designed the attacks to start with those based on visual target acquisition. Next, the pilot flies an attack against a preplanned target that is intitially beyond visual acquisition range. Finally, the pilot uses the Targeting Pod to aid in target acquisition and delivery as he performs armed reconnaissance of the target area. Since this mission also incorporates the most severely degraded weather the student will see, I have directed that the weather be raised to a less demanding level for the work on the range. Once this last daytime

mission is completed, the pilot will be ready for the greater challenge of night.

Mission 0-4 is the first night scenario, and the weapons delivery training drops back to simple tasks to allow the student to adjust to this more demanding environment. The student is back on a scorable gunnery range, the weather is clear, and the first weapons deliveries are level CCRP utilizing the Targeting Pod. From there the pilot transitions to slightly more challenging toss deliveries, then to level CCIP utilizing the LANTIRN HUD displays. The last weapons work is out of the thirty degree dive bomb pattern, a normally simple delivery, but complicated in this case by the night environment and the requirement to use the Targeting Pod. Overall, this mission is a straightforward introduction to dropping bombs at night with LANTIRN.

The next mission, 0-5, brings back laser guided bombs, slightly degraded weather, and the tactics range. These factors make the weapons training challenging in and of themselves, but this is alleviated by making the actual delivery events identical to those practiced on Mission 0-2. Remember that 0-2 was also the last time the student worked with LGB's. Consequently, the weapons delivery events flown on the earlier 0-2 scenario are the logical choice for the first LGB work at night. The resultant training will be effective and at the correct level of difficulty.

Mission 0-6 challenges the pilot with severely degraded weather, the tactics range, and the AGM-65 missile. However, at this point in his training the pilot's proficiency level should be approaching that needed for graduation from the program. By this time, he will have flown with the LANTIRN system in the actual aircraft and done real weapons deliveries; this mission scenario builds on that experience. Consequently, his AGM-65 weapons deliveries begin with attacks on preplanned targets, forcing him to use the other aircraft systems and the Targeting Pod to identify and destroy the target. Next, the student is tasked to do visual attacks by using the Targeting Pod to detect targets of opportunity. The first such attacks are simple visual attacks; later attacks involve armed reconnaissance tactics. By the end of the range work, the pilot should have confidence in his ability to use the LANTIRN system to put his bombs on target.

The last mission allows the pilot to confirm his skills with LANTIRN in the night environment. As discussed

earlier, this mission is flown as a simulated combat sortie to challenge the pilot with those conditions that may be expected in the actual aircraft. Because this scenario simulates a high threat area, the weapons delivery is a simple one pass attack. However, to allow more than one weapons pass, the pilot is also tasked to perform armed reconnaissance after he hits his primary target. Once he completes this mission, his skill level should be high.

In summary, weapons training is built around the three weapons expected to be used in operational LANTIRN units. Consistent with the building block approach (4:9), training progresses from simple free fall munitions in the daytime to AGM-65 Maverick deliveries at night. Completion of this training will teach the upgrading LANTIRN pilot to successfully kill the targets he is fragged against.

Chapter Six

THREAT REACTION TRAINING

A pilot trying to attack a target from low altitude at night and under the weather faces one more major obstacle to mission completion: the threat. It goes without saying that a target worth attacking is also worth defending. Consequently, threat training needs to be emphasized in any combat training program. Simulator training for LANTIRN is no exception. A pilot upgrading under this syllabus will be challenged by a complex and capable threat array.

Like all training in this program, threat training will start with simple concepts and move to the more complex. To do this, I have relatively simple threats on the early missions and complex threats on the later missions. To avoid classifying this paper, I will not discuss specific threat capabilites here. However, a good rule of thumb with enemy surface-to-air missile systems is that the higher the number, the more capable the threat. For example, the SA-8 would have more capabilities than the older SA-2. Table 4 (next page) shows the general flow of threat training to be used in this program.

As Table 4 shows, the upgrading pilot is not given any threat training on Mission 0-1. As discussed earlier, this is the pilot's first exposure to the LANTIRN system, and the limited amount of simulator time available on the mission needs to be spent familiarizing him with the basic operation of the system. In the same way, Mission 0-2 only requires the pilot to detect threats, and the threats he faces are relatively simple. Remember that this mission is also a pilot's first look at the Targeting Pod; the emphasis needs to be placed on the basic LANTIRN system before the student is challenged with more complex tasks. This may initially look as though threat training is being slighted. However, LANTIRN training is not a pilot's first exposure to threat reactions. To be eligible for LANTIRN training, a pilot must have completed more basic F-16 training, and threat

training receives a great deal of emphasis in those programs. Consequently, a pilot upgrading to the LANTIRN system needs to receive threat training that builds on his prior experience while still allowing him ample opportunity to learn the complex new LANTIRN system.

	Time of Day	Threat	Activity
O-1	Daytime	None	None
O-2	Daytime	Radar guided AAA SA-2 and SA-3	Detection Only
O-3	Daytime	Radar guided AAA SA-3 and SA-6	Basic defensive maneuvering
O-4	Night	Radar guided AAA SA-3 and SA-6	Basic defensive manuevering
O-5	Night	Radar guided AAA SA-6 and SA-8	Defensive manuevering and ECM
O-6	Night	Radar guided AAA SA-8 Air threat	Defensive maneuvering ECM, air threat detection and attack
O-7	Night	Instructor option plus Air threat	Defensive maneuvering ECM, air threat detection and attack

Table 4: Flow of Events for Threat Training

Mission O-3 finds the pilot performing his first defensive maneuvering. The threats used are capable, but an upgrading pilot will have received training against them in earlier courses. Remember that Mission O-3 is the last daytime scenario and that the weather is planned to be poor. This gives him the opportunity to review his basic defensive maneuvers in poor weather in the daytime before moving on to night. There should be ample time available on this mission to hone his skills for the challenges that come later.

Mission O-4 finds the student in the dark for the first

time, but with good weather. As we discussed earlier, night operations can easily disorient a pilot because of the lack of familiar daytime visual cues. Consequently, defensive manuevering can be expected to be more challenging than in the daytime, even with good weather. For this reason, the threat array the pilot will face is exactly the same as the previous mission. He will be able to practice skills he should already know, with the only additional challenge being the element of night. Threat training on this mission will be a good foundation for the missions that follow.

The next mission, O-5, adds one new threat, slightly degraded weather, and the need for the student to demonstrate his use of electronic countermeasures (ECM). As was the case with basic defensive manueuvering, ECM employment is learned in earlier training programs. However, incorporating the proper cockpit switchology in the dark in degraded weather with the new and complex LANTIRN system will challenge the pilot more than his earlier training could have. This mission builds on previous knowledge while challenging the pilot with the tasks associated with the LANTIRN low level mission. It will allow him to learn to defeat enemy defenses while maintaining his situation awareness and avoiding the ground impact hazard.

Mission O-6 is incrementally more challenging with the addition of an air threat. A pilot is expected to counter the ground threats he faces and to negate an attack from an enemy fighter. This does not mean that he will be doing low altitude dogfighting. Rather, his job is to counter the threat and go on to put his bombs on the target. There may be situations where the LANTIRN pilot will detect the threat with his onboard radar and manuever offensively to destroy it; he carries AIM-9M air-to-air missiles for just such a purpose. However, his primary mission is air-to-ground, and his training is designed to keep him oriented to that task and away from offensive air-to-air attack. The bottom line is that if he does not strike the target today, he (or someone else) will have to come back later.

As mentioned previously, Mission O-7 is a simulated combat mission. The student faces a capable surface-to-air missile threat and an air threat. His job is to get to the target, drop his bombs, and make it safely back to fight again. The weather will be poor and it will be night, making for a complex and demanding mission. I have not been specific about the threats on this mission, however. Instead, I recognize that the pilots training in this

program will be going to operational units in various parts of the world, and the threats they face will vary depending on where they will fight. This allows the instructor administering the simulator to tailor the mission toward the pilot's specific theater of operations. The end result will be maximum realism and the opportunity for the pilot to receive some excellent training.

In summary, then, threat training follows the same general philosophy as other training events. The student builds on earlier experience and hones his skills to face an increasingly complex threat array. A pilot receiving this instruction will be ready for the greater challenges of the actual aircraft.

Chapter Seven

CONCLUSION

The typical LANTIRN mission will probably be the most demanding flying an F-16 pilot will ever face. The threat from complex enemy defenses, the ground hazard, and the expected poor weather will all work against mission success. However, the pilot must succeed in his task of putting his bombs on target. His ability to do so will deny the enemy the cover of night and weather and allow friendly forces to prevail. LANTIRN will be the system that helps us to win.

To win in combat, you have to train in peacetime, and that training must be challenging but graduated to allow a pilot to learn effectively. This paper has presented such a simulator program for the LANTIRN F-16C pilot. The basic program gives him an introduction to the basic LANTIRN system and its mission. It teaches him basic system operation and its uses in delivering ordnance. As the pilot learns the system, the tasks are made more challenging, incorporating degraded weather, night, and complex enemy defenses. The last mission puts the fighter pilot on a simulated combat mission designed to be realistic, yet allow success and build confidence. Completion of this program will be a big step toward his goal of being combat ready.

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GLOSSARY

ACAL - Altitude Calibration

AGL - Above Ground Level

BIT - Built-in Test

CCIP - Continuously Computed Impact Point

CCRP - Continuously Computed Release Point

DTC - Data Transfer Cartridge

ECM - Electronic Countermeasures

FCC - Fire Control Computer

FLIR - Forward Looking Infrared

HUD - Head's Up Display

ILS - Instrument Landing System

IMC - Instrument Meteorological Conditions

LGB - Laser Guided Bomb

LOC - Line of Communication

NFOV - Narrow Field of View

PAR - Precision Approcah Radar

TFR - Terrain Following Radar

VMC - Visual Meteorological Conditions

WFOV - Wide Field of View

APPENDICES

Mission: O-1 1.5 Hours

OBJECTIVES: Introduce LANTIRN ground checks, AUTO and MANUAL TFR, FLIR use, and computed weapons deliveries on a scorable range.

SPECIFIC MISSION TASKS: Pre-takeoff BIT checks, FLIR boresight procedures, Navigation Pod setup for flight, AUTO and MANUAL TFR with FLIR, MANUAL TFR cockpit warning demonstrations, CCIP and CCRP level deliveries, ILS approach.

INITIAL CONDITIONS: OFT on ground at end of runway, engine running.

Configuration: 2 370 gallon tanks, Nav and Targeting Pods, 4 AIM-9M, 6 MK-82, ALE-40 loaded with chaff and flares.

Weather Conditions: Day, no ceiling, unrestricted visibility.

DTC Load: VR-223

Threats: None.

MISSION PROFILE:

- Ground Checks
  - DTC verification
  - Nav Pod BIT's
  - FLIR Boresight
- Takeoff
  - Afterburner
- Departure
  - VFR to the south
- Low Level
  - 480 knots
  - 500 feet AGL
  - AUTO TFR with FLIR
    - Engage AUTO TFR mode and monitor aircraft flight path, maintaining preplanned airspeed on first half of the route.
  - MANUAL TFR with FLIR
    - Change to MANUAL TFR and follow HUD TFR cues while maintaining 500 feet AGL, preplanned airspeed and preplanned ground track on the second half of the route. On one leg, intentionally induce all warning modes and observe indication and correct procedures to regain preplanned flight conditions.

Range Work

- Range entry
  - Utilize FLIR display to identify range layout.
- Weapon arming and cockpit setup

Weapons deliveries on Bomb Circle
- CCRP level
- CCIP level
- 30 Degree CCIP
- 20 Degree CCIP
- Low angle strafe

RTB
- ILS to 300' ceiling, 1 NM visibility

Post Flight Procedures
- Post-flight LANTIRN checks
- System shutdown

Mission: O-2 1.5 Hours

OBJECTIVES: Practice LANTIRN ground checks, AUTO TFR while performing INS and system altitude updates, FLIR use, and computed weapons deliveries on scorable range. Introduce IMC letdowns using TFR, 200' AGL low level operations, Targeting Pod setup and use, and LGB deliveries with self-designation.

SPECIFIC MISSION TASKS: Pre-takeoff checks, AUTO TFR with FLIR, CCIP and CCRP level deliveries utilizing LGB's with and without Targeting Pod designation.

INITIAL CONDITIONS: OFT on ground at end of runway, engine running.

Configuration: 2 370 gallon tanks, Nav and Targeting Pods, 4 AIM-9M, 6 LGB's, ALE-40 loaded with chaff and flares.

Weather Conditions: Day, 1000' ceiling, 4 NM visibility on the low level route; adjust to 1000' above the highest portion of the weapons delivery pattern on the gunnery range.

DTC Load: VR-223

Threats: Radar guided AAA, SA-2, and SA-3.

MISSION PROFILE:

- Ground Checks
  - DTC verification
  - Nav and Targeting Pod BIT's
  - FLIR Boresight
- Takeoff
  - Afterburner
- Departure
  - Instrument departure
  - Letdown to VMC using TFR
- Low Level
  - 480 knots
  - 500 feet AGL, transitioning to 200' AGL as comfort level permits.
  - AUTO TFR with FLIR
    - Engage AUTO TFR mode and monitor aircraft flight path, maintaining preplanned airspeed.
  - INS and System Altitude Updates
    - INS Overfly and/or HUD Fix
    - Radar Altimeter and/or HUD ACAL
    - Targeting Pod Fix and ACAL
  - Threat detection
    - Bring RWR into crosscheck as instructor gives threat warnings for AAA, SA-2, and SA-3. (No defensive manuevering - to be introduced on next mission.)

Range Work
- Range entry
  - Utilize FLIR display to identify range layout.
- Weapon arming and cockpit setup
- Weapons deliveries on Bomb Circle
  - 20 Degree CCIP Direct approach delivery without Tgt Pod
  - Level CCIP with Tgt Pod designation
  - 30 Degree CCIP with Tgt Pod designation
  - Toss deliveries using CCRP
    - Use Tgt Pod to identify target and designate for weapon delivery

RTB
- Low level range egress
- Low altitude engine failure, successful restart.
- PAR to 300′ ceiling and 1 NM visibility

Post Flight Procedures
- Post-flight LANTIRN checks
- System shutdown

Mission: O-3 1.5 Hours

OBJECTIVES: Practice MANUAL TFR while performing INS and system altitude updates, FLIR use, and computed weapons deliveries. Introduce defensive threat reactions in marginal VMC, AGM-65 daytime employment, and weapons deliveries on a tactics range.

SPECIFIC MISSION TASKS: Pre-takeoff checks, MANUAL TFR with FLIR, and AGM-65 deliveries against tactical targets.

INITIAL CONDITIONS: OFT on ground at end of runway, engine running.

Configuration: 2 370 gallon tanks, Nav and Targeting Pods, 4 AIM-9M, 6 AGM-65, ALE-40 loaded with chaff and flares.

Weather Conditions: Day, 500' ceiling, 4 NM visibility on low level route, 1500' ceiling, 4NM visibility on the range.

DTC Load: VR-245

Threats: Radar guided AAA, SA-3, and SA-6.

MISSION PROFILE:

- Ground Checks
  - DTC verification
  - Nav and Targeting Pod BIT's
  - FLIR Boresight
- Takeoff
  - Afterburner
- Departure
  - Instrument departure
  - Letdown to VMC using TFR
- Low Level
  - 480 knots
  - 200 feet AGL
  - MANUAL TFR with FLIR
    - Engage MANUAL TFR mode and maintain preplanned airspeed, altitude, and ground track.
  - INS and System Altitude Updates
    - INS Overfly and/or HUD Fix
    - Radar Altimeter and/or HUD ACAL
    - Targeting Pod Fix and ACAL
  - Threat Reactions
    - Detect threat
    - Practice defensive maneuvers at low altitude
- Range Work
  - Range entry
    - Utilize FLIR display to identify range layout

Weapon arming and cockpit setup
Weapons deliveries on tactics targets
AGM-65 attacks from visual target acquisition
AGM-65 attacks using preplanned target information
AGM-65 armed recce using Tgt Pod for detection and delivery

RTB
Low level range egress
TACAN approach to 500' ceiling and 1 NM visibility

Post Flight Procedures
Post-flight TANTIRN checks
System shutdown

Mission: 0-4 1.5 Hours

OBJECTIVES: Practice AUTO TFR while performing INS and system altitude updates, FLIR use, and computed weapons deliveries on a scorable range. Introduce LANTIRN night operations, TFR failure modes, and defensive threat reactions at night.

SPECIFIC MISSION TASKS: Pre-takeoff checks, AUTO TFR with FLIR, MK-82 deliveries against tactical targets.

INITIAL CONDITIONS: OFT on ground at end of runway, engine running.

Configuration: 2 370 gallon tanks, Nav and Targeting Pods, 4 AIM 9M, 6 MK-82's, ALE-40 loaded with chaff and flares.

Weather Conditions: Night, No ceiling, unrestricted visibility.

DTC Load: VR-223

Threats: Radar guided AAA, SA-3, and SA-6.

MISSION PROFILE:

- Ground Checks
  - DTC verification
  - Nav and Targeting Pod BIT's
  - FLIR Boresight
- Takeoff
  - Afterburner
- Departure
  - Instrument departure
  - Letdown to VMC using TFR
- Low Level
  - 480 knots
  - 500 feet AGL
  - AUTO TFR with FLIR
    - Instructor will input various TFR failure modes during the low level route. Pilot should recognize failure and take appropriate action.
  - INS and System Altitude Updates
    - INS Overfly and/or HUD Fix
    - Radar Altimeter and/or HUD ACAL
    - Targeting Pod Fix and ACAI
  - Threat Reactions
    - Detect threats
    - Practice low altitude defensive maneuvers

- Range Work
    - Range entry
        - Utilize FLIR display to identify range layout.
    - Weapon arming and cockpit setup
    - Weapons deliveries on Bomb Circle
        - CCRP level and toss deliveries
            - Use Tgt Pod to identify target and designate for weapon delivery
        - Level CCIP with Tgt Pod ranging
        - 30 Degree CCIP with and without Tgt Pod ranging

RTB

- Low level range egress
- ILS approach to 300' ceiling and 1 NM visibility

Post Flight Procedures

- Post-flight LANTIRN checks
- System shutdown

Mission: 0-5 1.5 Hours

OBJECTIVES: Practice AUTO and MANUAL TFR while performing INS and system altitude updates, FLIR use, and computed weapons deliveries on a tactics range at night. Introduce night LGB deliveries.

SPECIFIC MISSION TASKS: Pre-takeoff checks, MANUAL TFR with FLIR, LGB deliveries against tactical targets.

INITIAL CONDITIONS: OFT on ground at end of runway, engine running.

Configuration: 2 370 gallon tanks, Nav and Targeting Pods, 4 AIM-9M, 6 LGB's, ALE-40 loaded with chaff and flares.

Weather Conditions: Night, 1000' ceiling, 4 NM visibility on low level route; adjust to 1000' above the highest portion of the weapons pattern on the range.

DTC Load: VR-245

Threats: Radar guided AAA, SA-6, and SA-8.

MISSION PROFILE:

- Ground Checks
  - DTC verification
  - Nav and Targeting Pod BIT's
  - FLIR Boresight
- Takeoff
  - Afterburner
- Departure
  - Instrument departure
  - Letdown to VMC using TFR
- Low Level
  - 480 knots
  - 500 feet AGL
  - AUTO and MANUAL TFR with FLIR
    - Pilot will commence the low level with AUTO TFR and instructor will induce a failure mode that will require the student to revert to MANUAL TFR.
  - INS and System Altitude Updates
    - As required
  - Threat reactions
    - Detect threat
    - Practice low altitude night defensive maneuvers
    - Employ correct ECM

- Range Work
    - Range entry
        - Utilize FLIR display to identify range layout.
    - Weapon arming and cockpit setup
    - Weapons deliveries
        - 20 Degree CCIP Direct approach delivery without Tgt Pod
        - Level CCIP with Tgt Pod designation
        - 30 Degree CCIP with Tgt Pod designation
        - Toss deliveries using CCRP
            - Use Tgt Pod to identify target and designate for weapon delivery

- RTB
    - Low level range egress
    - PAR approach to 300' ceiling and 1 NM visibility

- Post Flight Procedures
    - Post-flight LANTIRN checks
    - System shutdown

Mission: 0-6 1.5 Hours

OBJECTIVES: Practice AUTO or MANUAL TFR while performing INS and system altitude updates, FLIR use, and computed weapons deliveries on a tactics range at night. Introduce very low altitude night operations, defenses against air threats, and night AGM-65 deliveries.

SPECIFIC MISSION TASKS: Pre-takeoff checks, AUTO or MANUAL TFR with FLIR, AGM-65 deliveries against tactical targets, and defenses against air threats.

INITIAL CONDITIONS: OFT on ground at end of runway, engine running.

Configuration: 2 370 gallon tanks, Nav and Targeting Pods, 4 AIM-9M, 6 AGM-65's, ALE-40 loaded with chaff and flares.

Weather Conditions: Night, 500' ceiling, 4 NM visibility on low level route, 1500' ceiling, 4NM visibility on the range.

DTC Load: VR-245

Threats: Radar guided AAA, SA-8, and air threats.

MISSION PROFILE:

- Ground Checks
  - DTC verification
  - Nav and Targeting Pod BIT's
  - FLIR Boresight
- Takeoff
  - Afterburner
- Departure
  - Instrument departure
  - Letdown to VMC using TFR
- Low Level
  - 480 knots
  - 200 feet AGL
  - AUTO or MANUAL TFR with FLIR
    - TFR mode will be at pilot discretion, unless instructor feels that emphasis is needed in a patricular area due to past performance.
  - INS and System Altitude Updates
    - As required
  - Threat reactions
    - Detect air threat
    - Practice low altitude night defensive maneuvers
    - Employ correct ECM
    - Attack air threat if not detrimental to mission accomplishment.

- Range Work
    - Range entry
        - Utilize FLIR display to identify range layout.
    - Weapon arming and cockpit setup
    - Weapons deliveries
        - AGM-65 attack using preplanned information
        - AGM-65 night visual attacks based on target detection information from Tgt Pod
        - Armed recce of an LOC using Tgt Pod and radar to detect moving ground targets

NOTE: Instructor may vary weather conditions to make a more or less challenging scenario as student proficiency permits.

RTB
- Low level range egress
- TACAN approach to 500' ceiling and 1 NM visibility

Post Flight Procedures
- Post-flight LANTIRN checks
- System shutdown

Mission: O-7 1.5 Hours

OBJECTIVES: Practice a simulated combat mission in a high threat environment at night and at low altitude in poor weather, culminating in a successful weapons delivery.

SPECIFIC MISSION TASKS: Pre-takeoff checks, AUTO or MANUAL TFR with FLIR, MK-82 deliveries against tactical targets, and defenses against threats.

INITIAL CONDITIONS: OFT on ground at end of runway, engine running.

Configuration: 2 370 gallon tanks, Nav and Targeting Pods, 4 AIM-9M, 6 MK-82's, ALE-40 loaded with chaff and flares.

Weather Conditions: Night, 500' ceiling, 4 NM visibility on low level route, 1000' ceiling, 4NM visibility on the range.

DTC Load: VR-245

Threats: Ground threats at instructor discretion and air threats.

MISSION PROFILE:

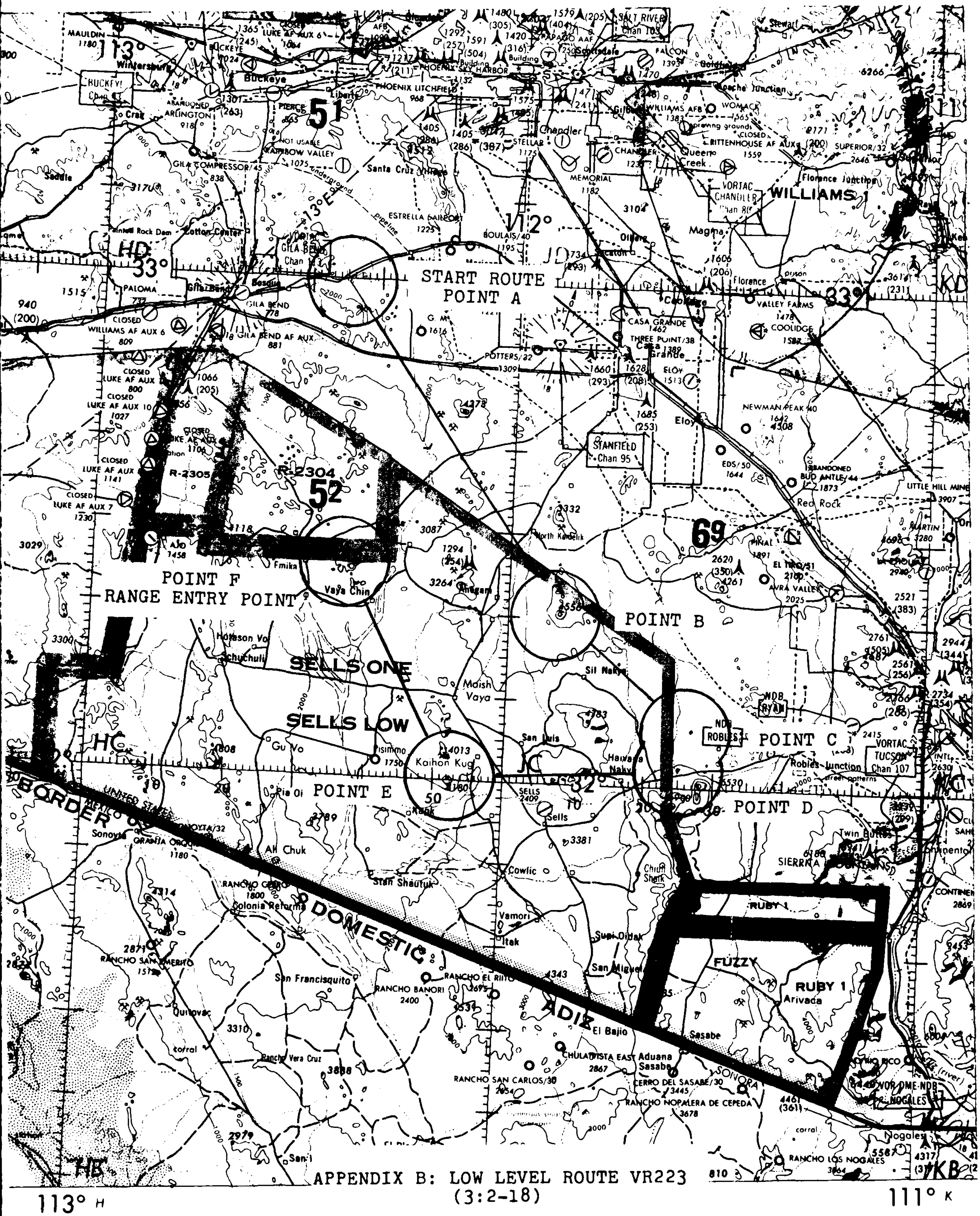
- Ground Checks
  - DTC verification
  - Nav and Targeting Pod BIT's
  - FLIR Boresight
- Takeoff
  - Afterburner
- Departure
  - Instrument departure
  - Letdown to VMC using TFR
- Low Level
  - 480 knots
  - 200 feet AGL
  - AUTO or MANUAL TFR with FLIR
    - TFR mode will be at pilot discretion, unless instructor feels that emphasis is needed in a patricular area due to past performance.
  - INS and System Altitude Updates
    - As required
  - Threat reactions
    - Detect threats
    - Practice low altitude night defensive maneuvers
    - Employ correct ECM
    - Attack air threat if not detrimental to mission accomplishment.

- Range Work
    Range entry
    Weapon arming and cockpit setup
    Utilize FLIR display to identify target area.
    Weapons deliveries
        Attack assigned target using preplanned
            information
        Armed recce of an LOC using Tgt Pod or radar to
            detect moving ground targets

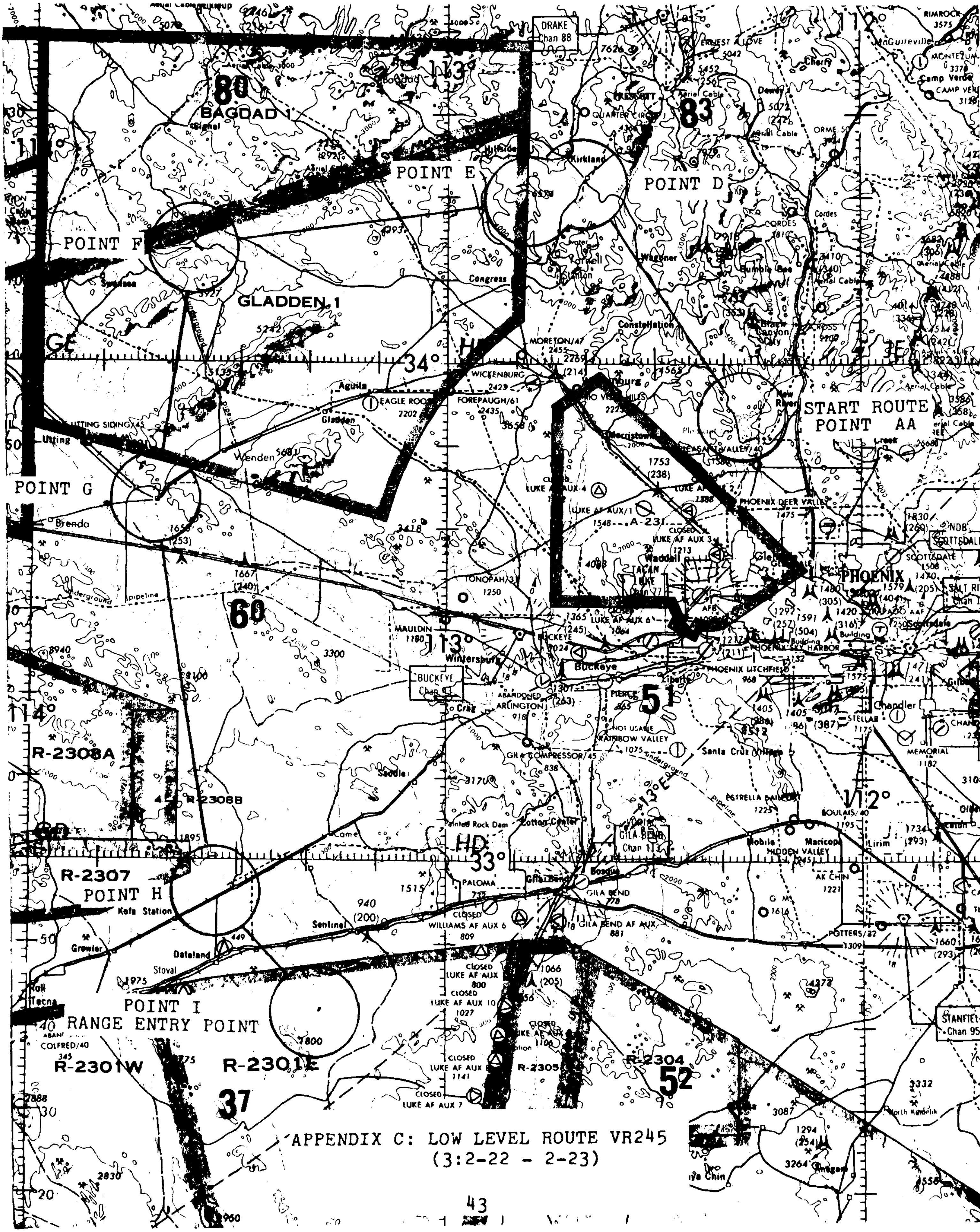
NOTE: Instructor may vary weather conditions to make it more
        or less challenging scenario as student
        proficiency permits.

RTB
    Target area egress
    In-flight report
    ILS or PAR approach to 300' ceiling and 1 NM visibility

Post Flight Procedures
    Post-flight LANTIRN checks
    System shutdown



APPENDIX B: LOW LEVEL ROUTE VR223
(3:2-18)



APPENDIX C: LOW LEVEL ROUTE VR245
(3:2-22 - 2-23)